The seven RBOCs and GTE were granted the right to:

- Provide local service
- Provide IntraLATA Toll Service
- Publish Yellow Pages directories
- Provide Directory Assistance services
- Use the Bell symbol (Not GTE)
- Direct Bell Communications Research (Bellcore) research and development facilities (Not GTE)

The seven RBOCs had to divest themselves of the ownership of residential and business inside wiring and telephone sets. In addition, they could no longer provide this type of equipment to end users. They initiated a campaign to sell their equipment, in place, to their customers. They could, however, charge a maintenance fee to fix any problems associated with the inside wiring. In addition, they can charge an end user a fee if a reported trouble is attributed to the customer premises inside wiring or telephone set.

End users were forced into buying a consumer appliance that had previously been supplied to them and maintained by the telephone company.

## FCC RULINGS ON MFJ

The FCC issued a number of rulings to define the operating principles of the MFJ. The rulings that had the greatest impact on the PSTN involve Equal Access. The RBOCs and GTE were required to provide fair and equal access to any and all IXCs. This access was to be equal to that given to AT&T. However, the default carrier was AT&T for any customer not choosing equal access or any telephone company not deploying equal access. Independent operating companies had to provide Equal Access if they received a valid request from any IXC. The methods for determining how and who would be assigned to an IXC were complicated and will not be discussed in this document. There are still areas of the U.S. and Canada that do not have Equal Access.

Instead of the seamless intertoll connection between the Bell operating companies and AT&T, the FCC defined four methods of access that could be ordered between LECs and IXCs. These were:

**Feature Group A** (FGA) service provides line-side access. With this service, a customer dials an assigned telephone number that connects to a specific IXC.

**Feature Group B** (FGB) service is trunk-side access where a subscriber dials a 950-0/1XXXX access code to reach the IXC.

**Feature Group C** (FGC) is the post-divestiture equivalent of the nonequal-access predivestiture arrangement provided to AT&T.

**Feature Group D** (FGD) service is a trunk-type termination affording call supervision to an IXC, a uniform access code, calling-party identification, recording access-charge billing details, presubscription to a customer-specified IXC, and Overlap outpulsing.

Technology advancements later developed **ISDN Primary Rate** as an access type.

IXCs became customers of the LECs. Common methods of ordering access were developed by the Ordering and Billing Forum (OBF). Charges were applied to the various access arrangements. These charges were a combination of fixed charges and usage charges. These charge arrangements were allowed in order to compensate the

LECs for costs involved in providing the access and the loss in toll revenue shared with them by AT&T. AT&T toll rates had been inflated to subsidize the provisioning of local service in high cost areas. This subsidy from long distance charges stopped with the MFJ. All telecommunications service providers now had to fund the provisioning of universal service. The National Exchange Carrier Association (NECA) was created to standardize and administer inter-company compensation funds.

IXCs could order access service at either the end office or at an Access Tandem (AT) operated by the LEC.

## Section 2 – Numbering Impacts

The most notable impact on numbering resources was the creation of Carrier Identifications Codes (CIC) and Carrier Access Codes (CAC) (see Appendix Table 3). The use of these codes in switch translations enabled a long distance call to be connected to the customer's IXC of choice.

## CARRIER IDENTIFICATION CODES (CIC)

Each IXC was assigned a three digit CIC by the NANPA. This code could be assigned to a subscriber's line to automatically route a long distance call to the customer's carrier of choice. In addition, the customer could choose a different carrier by dialing 10XXX before dialing the long distance call. In the 1980s, three digit CICs were exhausting. The industry met and expanded the CICs to four digits. All existing three digit CICs were converted to four digit CICs by inserting a 0 in front of the three digit CIC. For example, AT&T's three digit CIC was 288. After

CIC expansion, their four digit CIC was 0288.

## CARRIER ACCESS CODES (CAC)

In order to select an IXC, the customers could dial an access code that also contained a Carrier Identification Code (CIC) to reach a FGD carrier. Initially, the format of this code was 10XXX, where the XXX is the CIC. In order to allow a permissive dialing period where both codes could be used, the CAC was expanded to the format 101XXXX, where the XXXX is the value of the expanded CIC.

In order to access a FGB carrier, the customer dialed the access code 950-1/0XXX, where the XXX was the CIC. After CIC expansion, the FGB CAC became 950-XXXX, where the XXX was the four digit CIC.

## AUTOMATIC NUMBER IDENTIFICATION, IDENTIFICATION INFORMATION DIGITS (ANI II)

Automatic Number Identification (ANI) "II" digits are two digits that are sent with the calling telephone number identifying the type of originating station (for example, Plain Old Telephone Service [POTS] [00], Hotel/Motel [06]). Assignments of new ANI II digit pairs are assigned by the Industry Numbering Committee (INC). The NANP administrator is responsible for tracking the assignments of ANI II digit pairs. Listings of assigned ANI II digit pairs can be obtained from the NANPA.

Prior to Equal Access, ANI II digits were only single digits. This limited the number of station types being identified to only ten types. The expansion to two digits, gives the industry 100 types of stations that can be identified.

## Section 3 – Switching Impacts

### EQUAL ACCESS END OFFICES (EAEO)

The MFJ and its corresponding FCC rules had significant impacts on the switching systems used to handle telephone calls. The old Class 5 End Office became an Equal Access End Office (EAEO). If the office could not be converted to Equal Access, it became a non-conforming End Office. Each EAEO had to be able to route a toll call in exactly the same manner to each IXC that served the customers in the area of the EAEO. This necessitated the establishment of call routing based upon the CIC. This routing was performed by assigning the CIC to a subscriber's line. This became known as the Primary InterLATA Carrier (PIC). The method of signaling and information forwarded to the IXC was also expanded. In many instances, older electro-mechanical switching systems had to be replaced by newer technology.

### TOLL SWITCHES FOR IXCs

The new IXCs had to obtain switching systems to handle the traffic being sent to them by the LECs. Initially, they were unable to purchase toll tandem switches from AT&T. In many instances, the new IXCs used PBX equipment modified to perform toll tandem functions. These systems had limited signaling capabilities and less than desirable transmission quality. It did not take long for other switch manufacturers to start producing toll tandems for this market.

### MULTIPLE LD NETWORKS

In the early 1970s, the FCC allowed competition in the handling of private networks attached to the PSTN. This opened the way for companies to construct these network facilities. The most notable of these was MCI and Southern Pacific Railroad. Southern Pacific Railroad created Southern Pacific Communications. Southern Pacific sold their operation to GTE. GTE merged the operation with United Telephone's US Tel which resulted in US Sprint. United Telephone bought out the GTE portion. The resulting merger of UTS and US Sprint is called Sprint.

There were a number of companies waiting for the MFJ so that they could enter the long distance telephone business in competition to AT&T. Some of them, like MCI and Sprint, had actually begun construction of the facilities necessary to complete this task. Instead of a common seamless Long distance network, this produced a multitude of long distance networks, most of which did not interconnect with each other. Some regional long distance carriers developed business agreements with other regional carriers to interconnect and carry each other's traffic. This gave these carriers a much larger network footprint. In many instances, these carriers handed off traffic to AT&T to reach areas that were not profitable to connect. This created an illusion of a nationwide network.

Multiple carriers handling traffic to and from the LECs created the need to increase the amount of information contained in the Bellcore Local Exchange Routing Guide (LERG). This information was necessary for the IXCs to determine how a call was to get to and from a LEC's switch and who owned the LEC.

### LONG DISTANCE NETWORK TOPOGRAPHY

Prior to the MFJ, the maximum amount of times a toll call could be tandemed, once it went from a Bell company to AT&T, was six. After the MFJ, an InterLATA call would be delivered to an IXC and the number of times a call could be tandemed in

the IXC network was never specified. This tandem situation became more complex as IXCs merged or acquired each other and attempted to utilize multiple switching networks that resulted from the merger or acquisition.

The only regulatory rule on tandeming is that a LEC can only tandem a call once before it is delivered to an IXC.

## SIGNALING CHANGES

Prior to Equal Access, the End Office forwarded the called number to the next switch in the hierarchy. If the next switch recorded the billing information, it signaled the originating switch to forward the calling number for recording.

After Equal Access, the EAEO forwards the calling number, the CIC of the IXC and various other information in a first stage. The call is passed to the IXC and the IXC can query a data base to determine if this caller is a valid customer. The IXC then signals back to the EAEO and the EAEO forwards the called number to the IXC. This connection can be direct from the EAEO to the IXC or transit through a LEC Access Tandem.

The Bellcore requirements for signaling specified two different formats. One format was for IntraLATA signaling and the other was for InterLATA signaling. This enabled the offering of services that would only apply to the LATA. Later, the FCC ordered that Calling Number Delivery must be delivered on InterLATA calls.

## TOLL FREE NUMBERS

In the late 1960s, AT&T introduced Inward Wide Area Telephone Service (INWATS) as a dial access, to collect calls. This replaced the old manual operator Enterprise, Zenith and WX services. This

service was later renamed "800 Service" because it utilized the N00 Code, 800. After the MFJ and the implementation of Equal Access, these numbers had to be shared with other IXCs. This was done by assigning specific CO Code portions of the 800 number to specific carriers. He only draw back to this was that customers had to change their toll free number if they wanted to change their IXC.

In the mid 1990s, the U.S. FCC ordered that toll free numbers must be made portable and that calls must route on the carrier chosen by the holder of the toll free number versus the carrier chosen by the calling party. This necessitated the construction of a data base that would contain information about the toll free number, including the IXC of choice. The system requirements were developed by Bellcore. The system is called 800 Service Management System (SMS/800). Bellcore created a separate subsidiary to operate and manage SMS/800. This subsidiary is called Database Service Management Inc. (DSMI). Guidelines for the operation and administration of SMS/800 were developed by the Ordering and Billing Forum's (OBF) SMS/800 Number Management Committee (SNAC). The SNAC is a standing committee that is constantly overseeing and improving the system.

This capability was called "800 Number Portability". 800 Number Portability utilizes SS7 Signaling and an Intelligent Network (IN) trigger in to provide the caller's switch the necessary information to properly route and rate the call. This deployment of SS7 down to the EAEO level paved the way for future capabilities discussed later in this document.

## ROUTING REQUIREMENTS

Before Equal Access, toll calls routed via the AT&T Nationwide Toll Dialing

Plan as illustrated in the Appendix, Figure 1. Following Equal Access, IntraLATA toll calls routed on the LEC network. InterLATA toll calls routed to the IXC chosen by the end user. This end user choice could be selected by the Primary InterLATA Carrier (PIC) assigned to the subscriber line or by using the "dial around" carrier access code, 10XXX. This is illustrated in the Appendix, Figure 2.

EAEO switch translations were developed that recognized NPA NXX code combinations to be categorized as local, IntraLATA toll, InterLATA toll or International Toll. Calls to these various toll regions can be routed over separate trunk groups for different connections, cost allocations and regulatory jurisdictions.

## AMA REQUIREMENTS

Prior to Equal Access, message detail recording equipment could be installed in the local central office or at a centralized point, usually the toll tandem office. If it was in the End Office, it was called Local Automatic Message Accounting (LAMA). If the toll recording equipment was centralized, it was call Centralized Automatic Message Accounting (CAMA). AMA records were fairly simple in that they only needed Called Number, Calling Number, Time of Connect, Time of Disconnect, and Type of Originating Service (e.g. Regular, Coin, Hotel/Motel)

Equal Access requirements stipulated that toll message accounting equipment must be installed in each EAEO. This requirement was a stumbling block for deployment of Equal Access in small independent telephone companies. Some switch manufacturers developed a work around for this requirement that minimized some of the costs associated with the provision of Equal Access.

AMA records for these different toll jurisdictions contain different information that must be extracted in downstream processing by the Revenue Accounting Office (RAO).

The information needed for customer and carrier records needed much more granularity. All of this additional information had to be added to the AMA records. Additional memory and media storage was added to gather and store the information.

In addition the various access feature group AMA records each contain unique information.

Each EAEO generates AMA records that are billable back to the originating customer and AMA records that are billable to the IXC associated with the applicable access method.

## INTRALATA COMPETITION

By the early 1990s, the IXCs had deployed sufficient facilities to cover almost all of the U.S. Some of these IXCs petitioned state public utilities commissions for the ability to compete with the LECs for IntraLATA toll traffic. States began granting this request. This produced a requirement that LECs must offer their customers a choice for IntraLATA toll carrier. This choice of carrier could be different than the customer choice for InterLATA toll carrier.

Specifications and switch modifications were done to allow customers to route calls to separate carriers for InterLATA and IntraLATA toll calls. This required that two PICs be assigned on each line.

## CANADIAN EQUAL ACCESS

By the middle of the 1990s, Canada decided to implement Equal Access. However, they did not create multiple LATAs as in the United States. In Canada, all toll calls were fair game for competition. Since there is only one LATA, signaling and AMA recording is simplified.

## CUSTOM LOCAL AREA SIGNALING SERVICES (CLASS)

In an effort to increase local revenue, the RBOCs had their Bellcore subsidiary develop specifications for revenue producing features that could utilize the new computer controlled switching systems capabilities. This development included a number of features grouped together under CLASS. The most notable feature associated with CLASS is Caller ID. CLASS features necessitate the use of SS7 signaling.

The use of these features required the expansion and standardization of Vertical Service Codes. These codes are in the format of *XX with the future being *XXX. Vertical service codes are a numbering resource administered by the North American Numbering Plan Administrator.

## CMRS INTERCONNECTION

Soon after the MFJ, CMRS carriers began to interface into the PSTN. The existing incumbent exchange carriers choose to interface the new CMRS carriers in much the same way as their networks interfaced existing IMTS operations and large Private Branch Exchanges (PBX). These methods produced definitions for what is known as **CMRS Type 1** and **Type 2** interfaces. These interconnection / interoperability agreements produced some numbering inefficiencies in some areas.

Most CMRS carriers are not required to provide equal access to all long distance carriers. Most CMRS service providers have business arrangements with, and connect directly to, specific long distance carriers. CMRS carriers are not subject to state regulatory rulings and do not have to comply with LATA or state boundary restrictions.

## Section 4 – Billing Impacts

In addition to the toll bills rendered to each end user, the telephone company had to develop a billing record to charge IXCs for accessing the customers served by the LEC. This additional billing record is called Carrier Access Billing (CABS). Switch recording of toll call record information had to be expanded to contain all of the additional information needed for proper billing and revenues compensation arrangements. In addition, LECs made business arrangements with IXCs to bill and collect for toll calls on the regular monthly bills.

## Section 5 - Non-tangible Consequences

The break up of AT&T caused a number of non-tangible decisions that would affect the delivery of telephone service for decades to come. The most notable was the transfer of people back and forth between the Bell Operating Companies and AT&T. In most instances, there were more people than available jobs. This was based on business models that were driving lower cost service, irregardless of any other aspect. This resulted in loss of thousands of technical jobs and expertise. Based on the business models put in place at the time, there was no driver for Service quality or Public Safety/Security as the pure profit/margin, dictated by competition, ran the show.

The Bell Operating Companies maintained a certain common approach to requirements by funneling all feature development and product requirements through Bell Communications Research Corporation (Bellcore). These requirements could only apply to products and services that were deployed within each respective LATA. These requirements still carried the switching and network perspectives from the Bell System.

The LECs and the IXCs formed industry forums that developed industry agreements for the resolution of interconnection and interoperability issues. This process was endorsed by the FCC in 1985. Bellcore provided the secretariat for most of these forums and the resulting agreements were incorporated into Bellcore requirements.

After the first few years of long distance competition, financial backers in the long distance industry determined that the easiest method for growth was to acquire the assets of other long distance carriers. This produced a number of mergers and acquisitions.

## THE PRESENT – 1996 – 2004

### Section 1 - Regulatory

#### TELECOMMUNICATIONS ACT OF 1996 (TA-96)

The basic premise of TA-96 allows competition in the local calling areas of telephone company rate centers. TA-96 created two distinct types of local service providers: incumbent local exchange carriers (ILECs) and competitive local exchange carriers (CLECs). The new local competitors cannot compete without telephone numbers. The new competitors cannot compete without connection to the rest of the PSTN. TA-96 also stipulates that customers must be able to keep their telephone numbers when they change to a different local service provider. This is called local number portability. TA-96 defines telephone numbers as being associated with Rate Centers and not Wire Centers. However, calls have to be routed to the switch serving the called number based upon the first six digits.

Section 251(e) of the Communications Act of 1934 (Communications Act), as amended by TA-96, grants the FCC plenary jurisdiction over the NANP and related telephone numbering issues in the United States. In fulfilling this statutory mandate, the FCC identified two primary goals. One is to ensure that the limited numbering resources of the NANP are used efficiently, to protect customers from the expense and inconvenience that result from the implementation of new area codes, some of which can be avoided if numbering resources are used more efficiently, and to forestall the enormous expense that will be incurred in expanding the NANP. The other goal is to ensure that all carriers have the numbering resources they need to compete in the rapidly growing telecommunications marketplace.

Due to the homogeneous nature of the NANP, the FCC's jurisdiction cannot be segregated to just the U.S. portion of it. The FCC's seizure of the NANP, and hiring of a NANP administrator, did not take into any consideration the needs of the other 18 nations that utilize NANP resources. This is exemplified by the fact that the FCC assigned all of the remaining N11 codes for uses in the U.S.

In order to facilitate the growth of competition in local telephone service, the FCC further ordered that the incumbent service providers must allow their

competitors to have fair and equal access to their operational support systems that provision the service.

## TA-96 IMPACT ON THE KINGSBURY COMMITMENT

In December of 1913, AT&T agreed to sell off its interest in Western Union, purchase no more independent telephone companies and allow independent companies access to the AT&T long distance network. TA-96 relieved the RBOCs from the commitment not to actively acquire other telephone companies. The importance of this will be discussed later in this document.

## Section 2 – Numbering Impacts

## CONTRACT NUMBERING ADMINISTRATION

TA-96 further ordered the FCC to designate one or more impartial entities to administer telecommunications numbering and to make such numbers available on an equitable basis. The Act gave the FCC exclusive jurisdiction over those portions of the North American Numbering Plan that pertain to the United States. In turn, the FCC has given states this jurisdictional responsibility. Due to the universality of the NANP, determining exactly what pertains to the U.S. cannot accomplished without affecting the other countries involved in the NANP.

In the pursuit of this jurisdiction, the FCC declared that telephone numbers were a *national resource* that needed regulatory jurisdiction. The new FCC Numbering Resource Optimization rules have added considerable operating costs and administrative burdens to all operating telephone companies and countries that utilize NANP resources.

During the hearings associated with the Telecommunications Act of 1996, various industry segments alleged that the Bellcore North American Numbering Plan Administrator (NANPA) favored the RBOCs. The FCC appointed an advisory body to determine the future of the NANP and who the NANPA should be. This FCC advisory body is called the North American Numbering Council (NANC). Industry Numbering Committee (INC) Guidelines were used by the NANC and the FCC to derive a Federal Procurement specification for selection of a vendor to be the NANPA. The federal procurement process selected Lockheed-Martin as the new NANPA in 1996. The NANPA function of Lockheed Martin became NeuStar in December of 1999. Federal Procurement again selected NeuStar as the NANPA in 2003. The mission and scope of the NANC has produced culture clashes between various industry and regulatory segments that participate in it. The service providers need and use numbering resources based upon the design and philosophy of network design. The regulators need to control the numbering resources for consumer protection. These two philosophies produce numerous clashes between segments.

The telephone companies did not object to the seizure of number administration. They allowed this to happen under the guise of being allowed to enter the lucrative long distance business in competition with the IXCs. Hind sight shows that this was a poor decision. Considerable effort and expense is now being expended by LECs to manage the interworking of industry, regulators and the NANPA with regards to numbering.

In my opinion, the centralized administrator is not technically capable of knowing about conflicting numbering limitations in various company's networks. The administrator has

no way of knowing whether the number assignee is technically capable of providing the necessary PSTN interconnection capabilities. There are no mechanisms in place whereby the administrator can obtain this information.

## LOCAL NUMBER PORTABILITY

The FCC rules for number portability only apply to the top 100 Metropolitan Statistical Areas (MSAs) of the US. Wireline number portability was instituted in the 100 largest U.S. MSAs in 2001. Local Number Portability requirements were extended to CMRS service providers in November 2003.. In Canada, the portability requirement is only in the 25 largest MSAs of Canada. The initial FCC rules required each competitor to have a CO Code for each rate center served. Later, this was modified and the requirement was reduced to a thousand-block of an existing CO Code. An Area Code and Central Office Code combination contains ten thousand telephone numbers.

**The industry is not running out of telephone numbers. The industry is running out of Area Code and Central Office Code combinations due to this artificial demand.**

The INC developed the Central Office Code Assignment Guidelines (COCAG) that was used by the FCC / NANC to hire the new administrator for the NANP. The INC is constantly updating these guidelines to meet the needs of the FCC, industry and the NANPA.

Local Number Portability (LNP) requires the examination of the full ten-digit number in order to derive the proper six digits for call routing.

## LOCATION ROUTING NUMBER (LRN)

Local Number Portability further utilizes SS7 Signaling and an Advanced Intelligent Network (AIN) trigger to query a data base. The data base contains information about the actual switch location of the customer's telephone number. The data base returns the necessary routing instructions for call processing to the service provider making the query. This routing data is called a Location Routing Number (LRN). Once a Central Office Code is declared portable, all calls to numbers in the code must be queried to determine the actual switch serving the called number. In other words, the network must now route to the NPA NXX of the switching system of the LRN instead of the NPA NXX of the switching system that has the CO Code of the called number.

## THOUSANDS-BLOCK POOLING

The need for telephone numbers, by the competitive local exchange carriers (CLECs), accelerated the demand for additional Central Office Codes. A full CO Code has 10,000 telephone numbers. In order to slow the demand for additional codes, the FCC ordered that Thousands-Block Number Pooling be implemented in the 100 largest Metropolitan Statistical Areas (MSA) during 2001. Pooling allows different carriers to share ten, thousand-number blocks. The Pooling Administrator can issue numbers in thousands-blocks instead of issuing an entire Central Office Code. This increases the usable percentage of numbers, which decreases the demand for additional Central Office Codes. This has extended the life of various Area Codes and has resulted in the extension of the entire 10-digit NANP.

Pooling Assignment Guidelines for Thousands-Block Pooling was completed by

the Industry Numbering Committee. These guidelines were used by the U.S. Government Procurement Process in the selection of a National Pooling Administrator. The FCC accepted competitive bids for a national pooling administrator and selected NeuStar as the Pooling Administrator in 2001. The pooling implementation date was extended to allow the Pooling Administrator to implement mechanized systems. National Number Pooling, for Wireline Carriers, was implemented in March 2002. Pooling for CMRS Carriers was implemented in November 2002.

Thousands-Block Pooling utilizes the same technology as LNP. Calls to pooled codes are queried from the same data base as LNP. The data base returns the LRN to the querying carrier for routing to the switch that contains the Thousands-Block.

Thousands-block Number Pooling was mandated to the CMRS service providers in November 2002.

## Section 3 – Switching Impacts

## MULTIPLE LOCAL NETWORKS

TA-96 created multiple local carriers (CLECs) that compete to handle telephone traffic. This has added a new dimension to interconnection between local carriers and between the local carriers and the IXCs (See Appendix, Figure 3). This new dimension is the further division of the LATAs created by the MFJ. Again, this has created a need for additional information in the Telcordia™ rating and routing document data bases. This information is necessary for all industry segments to determine how a call is to get from the caller's switch to the called party's switch. This same information is necessary in order to

determine a caller's rate center and the called party's rate center for proper billing.

TA-96 also required the ILECs to unbundle the costs associated with the provision of local service and then lease the various parts to their competitors at wholesale rates. Two of these elements are the cable connections from the customer premise to the CO and the CO line equipment.

Once an ILEC proved that they had opened their local networks for competition, they could apply for and receive regulatory permission to provide InterLATA toll service, thus creating another set of networks.

## ROUTING REQUIREMENTS

The creation of multiple local carriers created another need for accurate routing information that would enable a call to reach the called telephone number. Again, the CLECs have different regulatory rules and different interconnection philosophies. They also lacked the knowledge and resources necessary to assure that the rest of the PSTN could route and properly bill calls to their customers. In addition, IXCs could now access entire local calling areas by routing directly to CLECs instead of routing through the ILECs. CLECs built tandem arrangements for this type of traffic without defining their tandem operations in routing guides.

In addition, number portability requirements changed routing requirements from the switch of the called number to the switch of the LRN. This has created complicated switch and signaling translations and routing.

## AMA REQUIREMENTS

In most of the large metropolitan areas in which local competition for telephone

service is operating, the ILECs operate the tandems necessary to interconnect all of the switching systems that serve the area. The new CLECs needed access to these tandems for access to the entire metropolitan area. The ILECs needed to charge the CLECs for handling this transit traffic in the same manner as they charge IXCs for access. This created the need to generate a local access bill at the tandem level for transit traffic generated to and from the CLECs. However, the ILECs no longer had a single voice (Bellcore) to develop a common switch AMA requirement. Instead, they chose to reclassify the local access trunking arrangements as toll trunking arrangements for the purposes of generating an access bill. This arrangement necessitated that the CLEC obtain a CIC. This arrangement creates problems when the tandem switch handles both local and toll traffic for the CLECs. When the CLEC receives the AMA records, they cannot determine what is local and what is toll.

## Section 4 – Billing Impacts

Customer billing is impacted by the fact that the same switch can be shared by multiple service providers. The switch only has one AMA capability that must be separated by downstream processing and then sent to the service provider for billing purposes.

Access billing records are also developed for the purpose of interconnection for CLEC switching systems.

In addition charges are levied between companies for data base queries associated with LNP data queries.

## Section 5 - Non-tangible Consequences

Since TA-96, no new wireline capabilities have been developed. The RBOCs no longer have a common voice when it comes to initiating capability specifications. Major changes, in wireline switching, only involve the capabilities for number portability and number pooling. In the meantime, CMRS service providers are constantly releasing new capabilities into their markets.

## Section 6 – Growth Through Acquisition and Mergers

Since TA-96, the major telecommunications companies have moved into growing their investment by merging or acquiring other service providers. As a result, the latest Bell Operating Companies are as follows:

- **SBC**
  Southwestern Bell Telephone Co,
  Pacific Telesis
  Ameritech
  Southern New England Telephone
  Co.

- **Verizon**
  Bell Atlantic
  Nynex
  GTE

- **BellSouth**

- **Qwest**
  US West

In addition, all of these companies have acquired CMRS subsidiaries.

## Section 7 – Competition in All Levels

The last approval has been issued that allows RBOCs to enter the long

distance business. The objectives of the MFJ and TA-96 have been accomplished. There is now competition in all levels of telephone service. The question is; have we done it right? Are all consumers benefiting from these objectives?

## THE FUTURE – BEYOND 2004

### Section 1 – Numbering

Following the implementation of local telephone competition and number portability, the initial code exhaust of the NANP was projected to occur in the year 2007. Implementation of Federal and state number resource optimization principles have extended the life of the NANP, but have initiated operational costs on service providers in order to manage the number assignments. The latest NANP exhaust projection has recently been estimated to be in the 2030s.

By that time, technology may have evolved to the point where telephone numbers might no longer be necessary.

### Section 2 – Switching - VoIP

The buzz word in communications is now Voice over Internet Protocol (VoIP). The communications providers and some users are pushing for the deployment of this technology. VoIP allows the combining of voice, data and entertainment over a single technology. This technology push is being driven by information technology providers. Information technology providers deploy "off the shelf" hardware and software to accomplish a business plan. In other words, the perspective of Internet developers is different than that of the definers of the PSTN. Internet standards developers talk of "carrier grade of service" and are trying to define exactly what is meant by that term

without the perspective of what the term meant in the past. Design of the PSTN was controlled by the service providers that developed the measurement criteria for determining grade of service and load service relationships for network provisioning. Switch vendors then constructed hardware and software to meet those requirements. This is another culture clash. Recent comments by some promoters of VoIP have suggested that the quality and reliability of the existing circuit switched PSTN are too expensive to deploy. They site as examples the present service problems associated with some CMRS technologies and that end users don't seem to be complaining about that.

Data transmission has always been included in the transport facilities provided by communications companies. Internet Protocol was created for a separate purpose other than to complete voice communications. The investment in its infrastructure was for that other purpose. Voice communications may well benefit from IP networks once the service and interoperability standards have been developed and deployed. However, co-existence methods must be developed to enable the new technology to be deployed into profitable markets and then grow into the other areas served by multiple technologies as economics dictate. These methods must be similar to those used by the telephone companies whenever technology changes occurred. In other words, dial telephone technology was invented in 1891, but was not fully deployed until the 1970s. Manual systems co-existed with dial systems for that entire period. There are still many people whose homes are equipped with the equivalent of the dial 500 set. The latest issue, of the Telcordia™ LERG™ Routing Guide still shows applications of

electro-mechanical switching systems deployed in the U.S.

With the exception of the packet links used to interconnect the PSTN signaling network, there are no U.S. standards for ordering, provisioning, accepting and testing of Data Packet Trunks (DPT). The lack of a common cohesive plan, and management, for the PSTN is delaying the development of these standards. The industry realizes the need, but each segment and provider expects others to fund and complete this work. Traditional PSTN switch vendors need common specifications for the industry. Legacy circuit switches contain all of the necessary dependability and survivability requirements that have evolved with the PSTN. Data packet router vendors have not needed to provide this degree of quality, so their development and manufacturing costs are much less than products developed with the quality of service capabilities needed by voice service providers.

There is a big difference between talking over the Internet and talking over an IP mediated network. Talking over the Internet is the easy part in the development of a totally reliable and survivable communications network that will results in corporate profit. Internationally, Internet standards have been developed by the Internet Engineering Task Force (IETF). This group is comprised by people with expertise in the Internet and data transfer.

Voice over the Internet service providers fail to point out that the end user must have a high speed connection to the Internet. Usually, this involves a Digital Subscriber Loop (DSL) connection to the telephone company or a cable modem high speed connection through a cable provider. These items add extra cost to the voice service and are dependent upon external electrical power

in order to function. As mentioned earlier in this document, people had phone service before they had electricity. **End users still need circuit access and must have electrical service in order to be able to call over the Internet.**

PSTN service providers and regulators must determine if the IETF standards are applicable to the PSTN. Do these standards need modification to include the more stringent standards needed for this technology to be used in the PSTN? Can the IETF standards co-exists and equate to existing PSTN standards? Internet Service Providers have claimed that they are immune from the service rules developed by PSTN service providers or imposed by federal and state regulators on the PSTN.

## Section 3 – Responsibility for Change

AT&T Network Planning was responsible for changes in the PSTN from its inception until the break up of AT&T in 1984. Between 1984 and TA-96, changes were controlled by the seven RBOCs. They had Bellcore develop specifications for changes. Since TA-96, there have been no changes and the industry has no common focal point to institute change specifications. The responsibility for change now lies with the entity that wants a change to happen. Very few industry participants have stepped up to this responsibility.

## Section 4 – End User Impacts

In the future, end user impacts will be largely dependent upon the technology that is deployed. It will probably involve the replacement of the instruments connected to the PSTN or the development of adapters to allow the use of legacy instruments.

# CONCLUSIONS AND RECOMMENDATIONS

The switching portion of the PSTN has been divided up; by the MFJ and TA-96. It is not managed or even universally coordinated. It is no longer one company and one network. The continued "opening of the network" to competition has caused it to become ever more complex, while at the same time losing the ability to manage it as a unified structure. The incumbent service providers cannot even reach agreements on interconnection and interoperability requirements without arguing about individual business impacts.

Telecommunications Service Providers are segmented into various categories. These categories are: IXCs. ILECS, CLECs, CMRS and Internet Service Providers (ISPs). In addition, all of these users of PSTN resources are not subject to the same regulatory rules on interconnection (See TABLE 4 in the Appendix).

**With the rules created by TA-96, the U.S. FCC has extracted the numbering portion of the PSTN without regard for the integration and coordination of the switching network that has to make the numbering decisions work.**

Getting telephones numbers from the contract numbering administrator does not automatically make these numbers work. The interconnection and interoperability of the switching network is vital to make the new numbers function. These numbers must be activated across the entire PSTN in order to function.

Under the guise of deregulation, the FCC has shared this numbering authority with various states. These states have made control decisions that affect the resources and policies of the entire PSTN.

**The onetime seamless telecommunications network is now a conglomeration of technologies and capabilities (see appendix figure 4).** The existing voice switching technology is still based upon the reliability requirements developed before TA-96. This reliability is keeping the PSTN functioning in overload or emergency situations.

**The PSTN is suffering from two decades of not being managed.** It is suffering from two decades of conflicting regulations placed upon the various segments that use its resources. Technology has rapidly evolved yet the rules and regulations that maintain the PSTN have not evolved. **Service providers have no common cohesive plan on how to use or manage the PSTN.** All decisions are based upon business cases that involve revenue opportunities. There are FCC standards for service and outage reporting. These standards are not being followed unilaterally by all participants. For instance IP service providers don't report service outages to the FCC and IP architecture does not use the same design and reliability standards.

In the operation of any communications system, only three things can happen to a service request. These are:
1. The request occurs
2. The request is delayed
3. The request is denied (blocked)

Business case developments for newer technology make no provisions for **service reliability or network survivability** or its use in emergencies and civil defense. CMRS and Internet connections to and from the PSTN have created serious complexities

(see appendix, figure 4) in the layout of network topography.

After TA-96, the Bell Operating companies sold Bellcore to SAIC and it became Telcordia Technologies. The result is that these **companies no longer have a common set of requirements** for the future direction of the PSTN.

The lack of a common U.S. position on how and where to evolve the PSTN has others looking to international standards for that direction. Adopting the international standards would tie the NANP PSTN into a common worldwide system. The existing NANP PSTN has gateways between international connections and itself to protect it from intrusion. The NANP PSTN can operate without connection to the rest of the world. Direct worldwide interconnection would expose the NANP PSTN to foreign intrusion that could affect its reliability and survivability. The Internet has exhibited its vulnerability to computer viruses and its vulnerability to unwanted messages (SPAM) that can delay the transmission of valid messages. The circuit switched world has evolved with the necessary safeguards to protect it from intrusion and even give certain traffic priorities in the event of emergencies. Even public safety trunked radio systems give priority to more important talk groups in the event of radio congestion.

The U.S. telecommunication industry has processes, in place, to develop and deploy common topography specifications. However, the cutbacks in resources and capital dollars have created a void in the necessary knowledge base necessary to develop these common specifications. In addition, the new competitors are not required to participate or even fund the process. Industry cutbacks caused by its

fragmentation and an economic downturn have exacerbated the knowledge void.

One such process is maintained by the Alliance for Telecommunications Industry Solutions (ATIS). The ATIS sponsored, OBF and INC are referred to in this document. Another industry process is maintained by the Telecommunications Industry Association (TIA).

The PSTN was developed to route a voice message from a calling number to a called number. The call routed from the caller's originating switch that contains the caller's NPA NXX, to the called party's switch, that contains the called party's NPA NXX. This routing scheme was designed with a finite number of routes. Each link in the route was provisioned with the same set of rules. Therefore, worst case overall service quality could be determined.

CMRS and voice over internet users know that they can always fall back on the wireline network. However, the decrease in wireline customers and the decrease in wireline infrastructure have degraded the wireline network. The degradations are becoming more common and the changes are so subtle that users are not recognizing that these changes are happening.

Since number portability, the routing of calls to a telephone number must first determine in what switch the number is located, receive the switch routing NPA NXX, and route via the correct path to that switch. In some instances, this may require additional interconnection facilities. It also forces each call to a portable NPA NXX to have to be data base queried. This capability puts the network intelligence in central data bases rather than each individual switching system. PSTN reliability and survivability standards were developed for these

connections prior to TA-96. New entrants and new technologies have not complied with the same reliability and survivability standards.

Considerable industry standards needed development in order to deploy the necessary technology that allows telephone numbers to be moved from one service provider to another. These standards were developed by the incumbent service providers based upon their industry perspective. The new competitive service providers have a different perspective of network operations. In addition, they do not have the same regulatory restrictions placed upon them. They are able to deploy alternative interconnections. Sometimes, these alternatives do not work or do not work well.

Prior to the break up of AT&T, the Bell System had stable guaranteed income levels. This enabled the Bell companies to concentrate on service quality and technical innovation. Bell Telephone Laboratories developed many innovative products and services while improving telephone service. After the MFJ and TA-96 industry innovation for the wireline industry segment has stopped. Telecommunications industry economic growth has been relegated to mergers and acquisitions. Telephone companies have had to concentrate on cost reductions. This has reduced their ability to react to service difficulties and development of new network capabilities.

## Section 1 – Conclusions

### THE REAL ISSUE

The NANP portion of the PSTN is administered, but the PSTN is not managed. In fact, there are very few people with the knowledge and impartiality to manage the PSTN. Early Bell System NANP management was compartmentalized. AT&T managed Area Codes and the Bell Operating Companies managed the Central Office Codes in each Area Code. The BOC's management of CO Codes was dependent upon switch technology. The PSTN is now tied to the architecture and interconnection agreements between users of PSTN resources.

As stated earlier, the PSTN is dependent on the seamless nature of the switching network. Different regulatory rules affect how calls get from the calling party to the called party. The end users do not care what technology is between them. When a message is left to call back a number, the caller has no idea what technology serves the called party. Uniform, PSTN wide routing instructions need to be maintained and used. Except for how a LEC connects to an IXC, there are no uniform interconnection standards. There is only, non-binding industry agreements.

Some interconnection problems could be dealt with before number portability and number pooling. With Number Portability and Number Pooling, problems are surfacing due to the different interconnection methods and regulatory restrictions of various PSTN users.

**Technology is evolving, but the PSTN's basic premises have not evolved to match the technology.**

**The real problem is the fact that the PSTN still routes and rates messages exactly the way it was envisioned in the 1940s.** This alters the way CMRS, CLECs and ISPs interconnect to the PSTN. These interconnect differences affect the way calls route and are properly billed and taxed. The

industry, as a whole, lacks the expertise to change it.

The section, of this document, on NANP FORMAT & VALUES states that the Plan is based on a "destination code" principle. Since the 1960s, there has been more of a move toward calling another person rather than a destination[16]. Wireless is the true application of this principle, especially in handling of CMRS roaming. Unfortunately, the telecommunications industry has not changed its concept of rating and routing to match that move. Inter-company billing and revenue sharing is still based upon the destination code principle. Government entity taxation rules and revenues are also based upon the jurisdiction of the origination.

Technology advancements are moving toward a personalized form of communications. Information is being supplied to people not to boxes. The technology of the network no longer cares whether that information is voice, data, or entertainment. The technology exists to move CMRS mobility to the wireline service providers. The distance sensitive portion of the network is no longer relevant to the needs of personalized communications. For example, a person can log on to any given point on the internet and retrieve their email. They are not tied to a desk at work or at home.

In addition, **the administration, handling and routing of telephone numbers is in at least five different data bases that do not communicate with each other.** Not one of these data bases is classed as the "one of record". The administrator of the NANP is a contract employee of the federal government. Any industry attempt at

change, or to implement process improvement, must work through the government procurement process.

## THE CLASH

After the break up of AT&T, the uniform switching plan began to unravel. The introduction of competing long distance carriers gave way to many long distance switching networks that were built using philosophies and switch capabilities developed in each of the companies. The only actual rules are how the existing exchange carriers interfaced to the interexchange carriers (IXCs). Once the call reaches the IXC, routing the call follows the methods developed by the IXC and with any other service provider that they have working agreements. Designing a network based upon network costs associated with access charges clashes with designing a network based upon quality of service and speed of connection.

Mergers and acquisitions produced complicated switching arrangements that needed to be dealt with. Dealing with merging or replacing combined companies' networks has become an economic disaster that can result in complicated uses of resources to minimize delays in call routing and call processing. Economic decisions to minimize access charges can also affect PSTN resources and pass the routing decisions on to another carrier.

With the proliferation of Internet communications, a clash has been created between traditional voice communications proponents and data communications proponents. The clash must be eliminated and the two philosophies merged in order to produce a network that is reliable and survivable. If that cannot be accomplished, some forms of subsidies must be provided to

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[16] This is the difference in "Station-to-Station" calls versus "Person-to-Person" calls.

enable a separate "back up" network to exist.

## CONSEQUENCES

There are two approaches that can be taken with the management and uses of the PSTN. The first approach is to do nothing and hope the problems will be solved by evolution. The only problem with that is making sure that the universal capabilities of the PSTN do not cease. Can the hodgepodge of technologies support the services and expectations of all users? Can the quality of service and the use of the service in emergencies be guaranteed? Can the various service provider segments continue to be economically viable?

The second approach involves major surgery. It would involve enabling all users of PSTN resources to have the same regulatory and interconnection rules. This would eliminate LATA and state boundary restrictions from incumbent wireline service providers. It would eliminate restrictions and taxation that are only applied to the incumbents. It would eliminate the distance sensitive portion of billing and would solely rely on time of connection. All service would then bill their customers by minutes of use.

Regulators need to concern themselves with the availability and survivability of the PSTN instead of concentrating on the pieces of the PSTN. Regulators must decide if all of the communications needs of consumers should be placed in one common system that must rely on the availability of external power in order to function. Regulators must decide if a network transformation should come as an immediate replacement or can it be phased in over a period of time as the market dictates.

The communications industry has been fragmented into competing segments that lack a common voice in the establishment of common interconnection and interoperability standards and specifications. Purchase decisions are being made on price factors alone, without regard to long range reliability and survivability.

The long range goals and plans authored by Theodore Vail, in 1885, have been negated by government intervention. These goals were; one system, one policy, universal service. We now have thousands of service providers routing traffic on hundreds of networks and the goal of universal service has not been accomplished.

The elements and companies that utilize various resources of the PSTN and provide services to end users must be able to interconnect and interoperate with each other. This is necessary for the seamless operation of the PSTN. This will provide the necessary safeguards for network survivability, reliability and interworking. The end users do not care what companies or what technologies are between them and the parties that they want to be connected with. The PSTN was created to be independent of the technology that is used. The PSTN was created to properly route and bill messages between two parties utilizing a decimal type numbering system. The technology independence is predicated on the assumption that interconnection and interoperability standards and regulations are the same for all service providers.

As stated earlier in this document, the MFJ and TA-96 opened the seamless network with different regulations and different standards for interconnection and interoperability. Decisions are now based upon business cases and not upon reliability and survivability. Financial growth has

been maintained through mergers and acquisitions rather than technical innovations.

All communications providers can now deliver local telephone service. All of the RBOCs have now been allowed to provide InterLATA toll service. ISPs can provide all services. However, the incumbent telephone companies are still restricted in methods of interconnection. Incumbents must still provide equal and fair access to all IXCs. CMRS and ISPs are not required to provide equal access.

There is no such thing as a wireless carrier. Once the CMRS caller reaches the first cell tower, the call becomes a wireline call. CMRS carriers are now in the process of merging and acquiring each other for economic growth. ISPs access the PSTN via existing access methods. Calls to and from the PSTN are delivered to the ISP who then accesses the terminal equipment by using the Internet as the means of transport.

## RECOMMENDED SURGERY

As stated earlier in this document:

- The PSTN is independent of the technologies used in its elements. It is a concept that is not technology dependent.
- End users do not care what technology is being used. They want results.
- CMRS service providers are really LECs with a unique method of access.
- ISPs need access to and from the PSTN to the Internet.
- There have been no innovations in wireline telephone capabilities since TA-96.

- The communications industry has no common goals or common directions on the future of the PSTN.
- Each company and segment is governed by separate business plans.

The MFJ and TA-96 were noble endeavors filled with good intentions. They were enacted to promote competition in the telephone industry. This was supposed to drive down costs. However, each new entrant developed separate business cases without regard for overall network integrity. Since their enactment, technology has rapidly evolved and the telecommunications industry has taken a great financial downturn. The time has come to rectify the mistakes made by these government intrusions into the now competitive telecommunications industry. Events have occurred that are causing the industry to re-assess its commitment to reliability and survivability. This commitment must be extended to any technology that is used for public communications.

In order for the communications industry to be truly competitive and be able to modernize its elements, all segments that are competing for the same subscribers need to be treated equally. Rules and regulations should be the same for all segments of the communications industry. All segments should provide services with the same degree of reliability and survivability. For example, on September 11, 2001, the internet universally slowed to a crawl. On the other hand, the telephone systems operated flawlessly, except in the areas of Washington, DC and New York City. Even in these areas, the network management controls performed their functions so as not to bring down the entire network. This was remarkable considering the destruction of switching systems and distribution cables in lower Manhattan.

Any next generation network needs to be able to handle and isolate natural disasters, man-made disasters and assassinations of public officials. At the same time, these systems must be able to deliver the same set of signaling parameters to enable emergency traffic to flow in and out of affected areas and these areas not be allowed to slow down the entire national network. All PSTN users need to agree on common specifications and network capabilities in order to provide a virtual seamless PSTN. All vendors need to supply equipment that meets those specifications. Purchasing and provisioning decisions need to be made, not only on business cases, but on network reliability and survivability. End users must be made aware of these requirements and not have to rely on one industry segment as the backup in the event of an emergency.

To these ends, I propose that all segments (ILEC, CLEC, IXC and ISP) be treated as equal service providers competing for the same customer base. CMRS providers and ISPs should interconnect and interoperate, with the PSTN, in the same manner as CLECs. I propose that all LATA and state boundary restrictions be eliminated. I propose that all service providers be held to the same set of regulatory rules (or not) and be taxed (or not taxed) equally.

The nation's communications systems need to be seamless and not subject to state by state variations. All technologies that utilize the system must be able to coexist. Ultimately, national boundaries will need to be eliminated except for gateways that insure national survivability and intrusion prevention.

Once LATA and state boundaries have been eliminated and taxation becomes equal, the distance portion of billed calls should be eliminated. All calls should be billed on time used, as is done in the CMRS segment. The time used will be charged to the originator. Various flat rate/measured rate plans can be developed for all segments that are similar to those used by the CMRS segment.

## Section 2 – The Answer

On the cover sheet of this document, I asked who was managing the PSTN. The answer, to that question, is that nobody is managing the PSTN.

## Appendix – Reference Tables and Figures

## TABLE 1: NANP ADMINISTRATIVE RESPONSIBILITIES

| Changes | Prior to 1984 | 1984 to 1996 | After TA 96 |
|---|---|---|---|
| Area Code Relief | AT&T Network Planning | Bellcore NANPA | NeuStar |
| Central Office Code Relief | Bell Operating Companies | Dominant Telephone Company in each NPA | NeuStar |
| Architectural Changes | AT&T Network Planning | Bellcore GR Process | Industry forum process |

## TABLE 2: STRUCTURE OF THE ITU RECOMMENDATION E.164 NUMBER FIELDS:

| CC | NDC | SN |
|---|---|---|
| 1 to 3 Digits | Max (15 - n) Digits | |
| | National (Significant) Number | |

——— Max 15 Digits ———
International Public Telecommunication
Number for Geographic Areas

Where:
CC  = Country Code
NDC = National Destination Code
SN  = Subscriber Number
n = the number of digits in the Country Code

## TABLE 3: COMMON WIRELINE CUSTOMER DIALED PREFIXES AND ACCESS CODES FOR ORIGINATING CALLS

| PREFIX OR ACCESS CODE | USE OF CODE |
|---|---|
| 0 | Telephone Company Operator |
| 0+10 Digits | Person Paid Collect Special (PPCS) Call |
| 00 | Long Distance Carrier Operator |
| 01 | International PPCS Call |
| 011 | International Station to Station Sent Paid (SSSP) Call |
| 1+ | Toll Access for SSSP Calls |
| *XX (*XXX) | Vertical Service Code Access |
| 11XX (11XXX) | Vertical Service Code Alternate (Permissive) Access |
| 101XXXX | Carrier Access Code (CAC), Feature Group "D" |
| 950XXXX | Carrier Access Code (CAC), Feature Group "B" |

## TABLE 4: PLAN ORIGINATING CALL TYPES AND CONVENTIONS

| DIGITS | FORMAT | CALL TYPE | COMMENTS |
|---|---|---|---|
| Zero Digits | Seizure (off hook) | Hot Line, Warm Line | Automatic connection to predetermined location |
| One Digit | 0 | Operator | Connection to LEC Operator |
| Two Digits | 00 | Operator | Connection to IXC Operator |
| Three Digits | N11 *XX | Services Vertical Services | Connection Activation of service, acknowledgment tone is returned to customer and dial tone is returned. |
| Four Digits | 11XX | Vertical Service from Dial Pulse phone | Activation of service, acknowledgment tone is returned to customer and dial tone is returned. |
| | *XXX | Vertical Service from a CMRS Phone | Activation of a CMRS service |
| Seven Digits | NXX-XXXX | Local Call | Call Completion |
| Ten Digits | NXX-NXX-XXXX | Local Call, where 10 digit local calls are required. | Call Completion |
| Eleven Digits | 1 NXX-NXX-XXXX | SSSP Call to another NANP location | Call Completion |
| | 0 NXX-NXX-XXXX | PPCS Call to another NANP location | Call Completion |
| | | | Note: These call types are routed differently dependent upon Intra-LATA or Inter-LATA jurisdictions. |
| Greater Than Eleven Digits | 01 + CC + CC + Number | International PPCS Call | Call Completion |
| | 011 + CC + CC + Number | International SSSP Call | Call Completion |
| | CC= Country Code and City Code | | Note: These calls can be from 12 to 15 digits plus the Access Code. |

## TABLE 5: 11X CODES (Used in SXS offices)

| 11X Code | Assigned Use |
|---|---|
| 112 | DDD Toll/Tandem/CAMA Switch Access |
| 113 | Directory Assistance (Information) |
| 114 | Repair Service |
| 115 | Mobile/Marine/Air-Ground/Conference Operator |
| 116 | Local Area Toll Station Operator |
| 117 | Test Board |
| 118-N-1 | Revertive Call (Multi 4/8/10/Rural Party Lines) |
| 119-1-1 | Revertive Call (Two-Party Lines) |
| 110 | Outward Toll Cordboard Operator |

## TABLE 6: N11 CODES

| N11 Code | Initial Assigned Use | 2004 Assigned Use |
|---|---|---|
| 211 | Future | Community Information |
| 311 | Future | Non-emergency access to government |
| 411 | Directory Assistance | Directory Assistance |
| 511 | Dial Speed Test | Traffic or Travel Information |
| 611 | Telco Repair Service | Telco Repair Service |
| 711 | Future | Telecommunications Relay Service |
| 811 | Telco Business Office | Telco Business Office |
| 911 | Future | Emergency |

## TABLE 7: N00 CODES

| N00 Code | Initial Assigned Use | 2004 Assigned Use |
|---|---|---|
| 200 | Future | Future |
| 300 | Future | Future |
| 400 | Future | Future |
| 500 | Future | Personal Communications Services |
| 600 | Future | Reserved for Canada |
| 700 | Future | IXC Services |
| 800 | INWATS | Toll Free Number Access |
| 900 | Mass Calling | Premium Services |

## TABLE 8: DUAL TONE MULTI-FREQUENCY SIGNALING

| | | HIGH-GROUP | FREQUENCIES | (Hz) | |
|---|---|---|---|---|---|
| | | 1209 | 1336 | 1477 | 1633 |
| LOW GROUP | 697 | 1 | 2 | 3 | A |
| FREQUENCIES | 770 | 4 | 5 | 6 | B |
| (Hz) | 852 | 7 | 8 | 9 | C |
| | 941 | * | 0 | # | D |

## TABLE 9: ADDITIONAL NUMBERING NEEDS OF CMRS SERVICE PROVIDERS[17]

| ACRONYM | MEANING | FORMAT | COMMENTS |
|---|---|---|---|
| ESRD | Emergency Services Routing Digit | 10 digit NANP # NPA-NXX-XXXX or 10 digit Fictitious numbers | Identifies the cell site and sector from which a CMRS E9-1-1 call originates. |
| ESRK | Emergency Services Routing Key | 10 digit NANP # NPA-NXX-XXXX or 10 digit Fictitious numbers | In addition to cell site and sector, Also identifies and delivers specific call data to the appropriate PSAP |
| IRM | International Roaming Mobile Identification number | 1/0-XXX-XXXX | Transitional terminal identifier for international CMRS Roaming |
| MBI | Mobile Block Identifier | NPA-NXX-XXXX | Will be used by LNP and roaming CMRS carriers for terminal identification. Can also be an MDN in another CMRS network. |
| MIN | Mobile Identification Number | NPA-NXX-XXXX | Same value as MDN. Currently used by CMRS carriers for terminal identification; can also be a MIN in another CMRS network |
| MDN | Mobile Directory Number | NPA-NXX-XXXX | CMRS subscriber's telephone number; same value as MIN; used for terminal identification |
| MSRN | Mobile Station Routing Number | NPA-NXX-XXXX | A number dynamically assigned on a per call basis to a CMRS roaming subscriber for call setup purposes. This is used for signaling in GSM/UMTS technology |
| TLDN | Temporary Local Directory Number | NPA-NXX-XXXX | A number dynamically assigned on a per call basis to a CMRS roaming subscriber for call setup purposes This is used for signaling in CDMA/TDMA/AMPS technology. |

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[17] This table information courtesy of Michele Young Enzweiler, Young Ideas, and Dana Smith, Verizon Wireless

## FIGURE 1 NATIONAL TOLL DIALING PLAN



——————— Final Trunk Group

– – – – High Usage Trunk Group
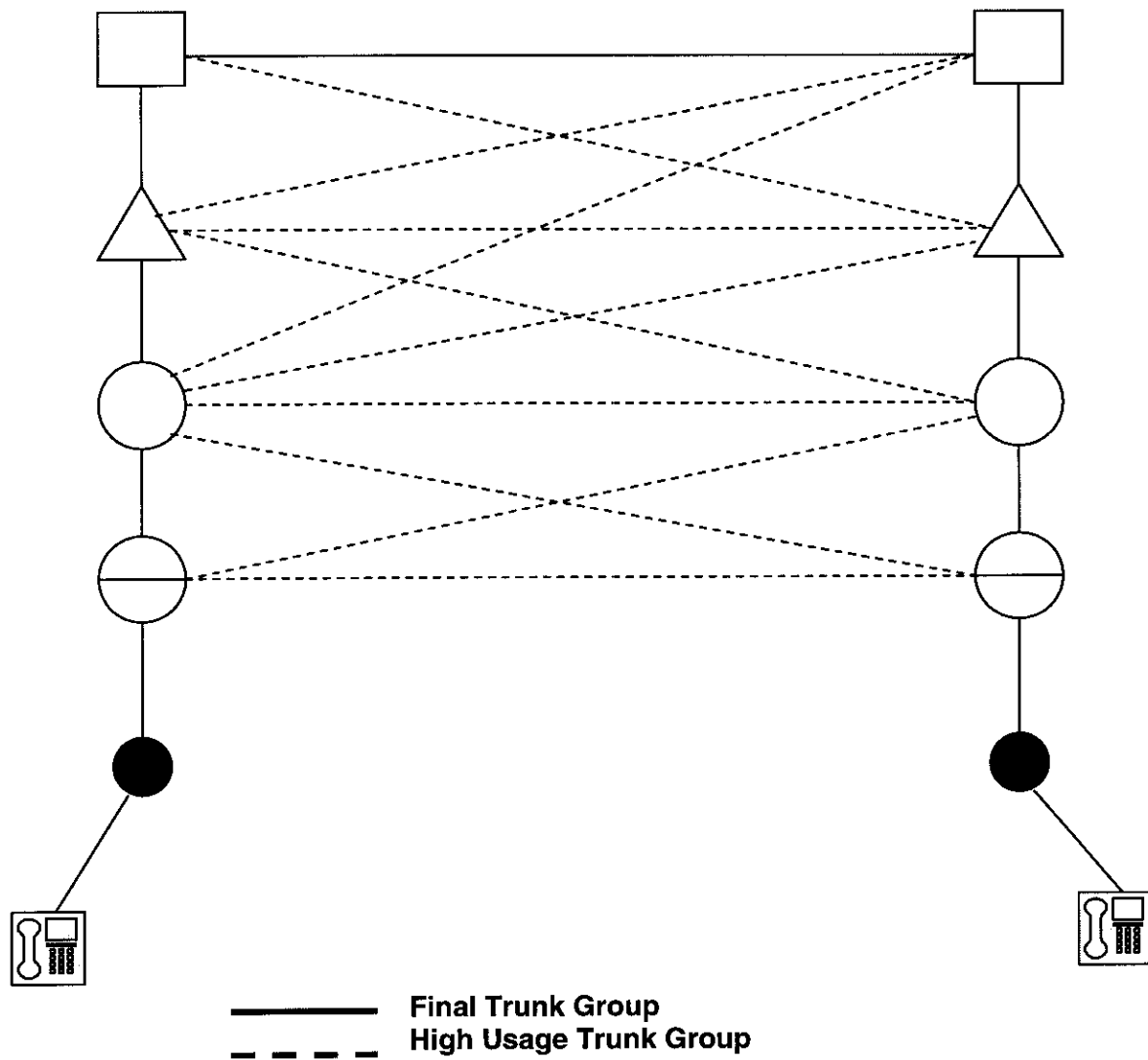
☐ = Class 1 Regional Center (RC)

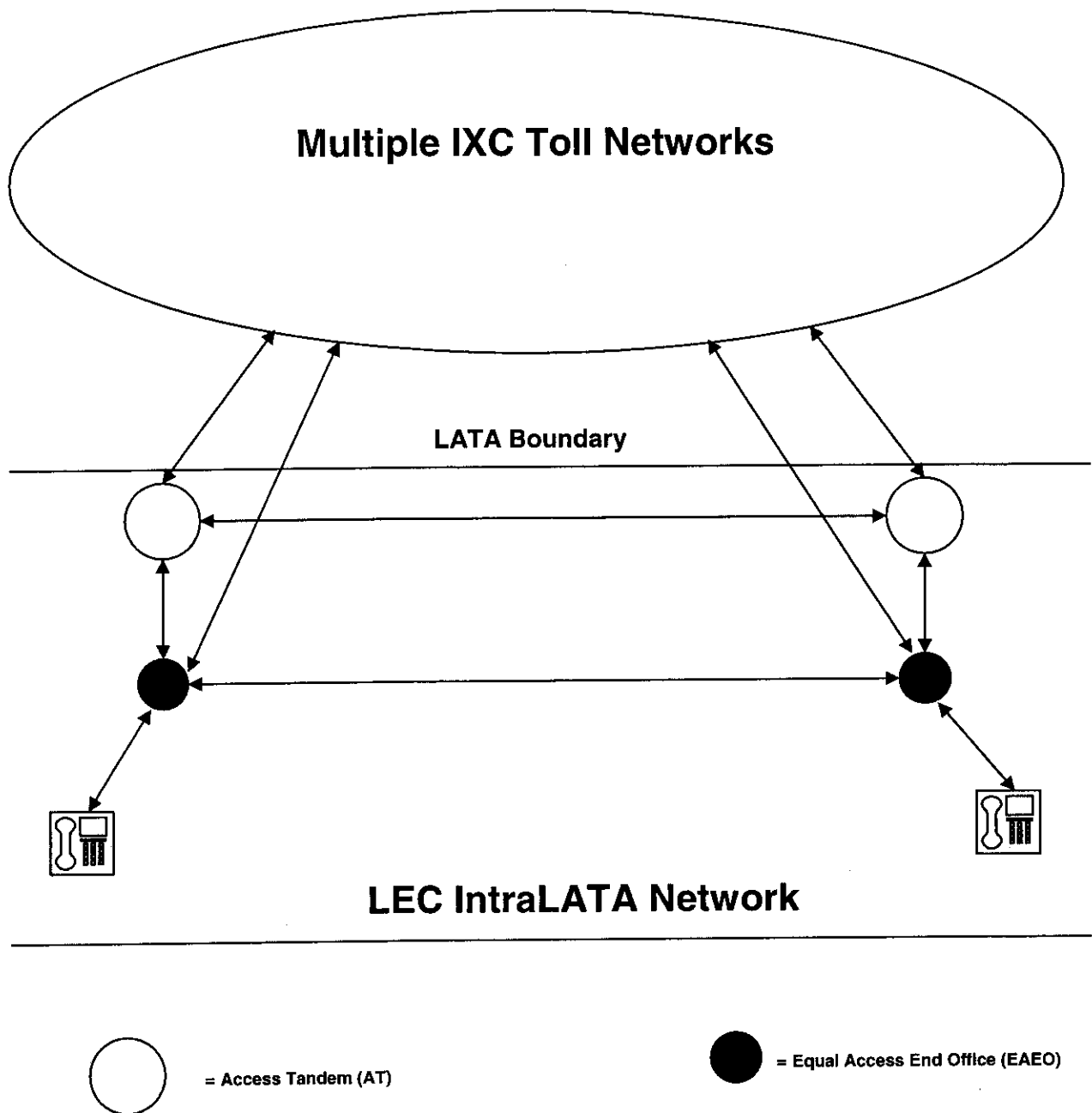△ = Class 2 Sectional Center (SC)

◯ = Class 3 Primary Center (PC)
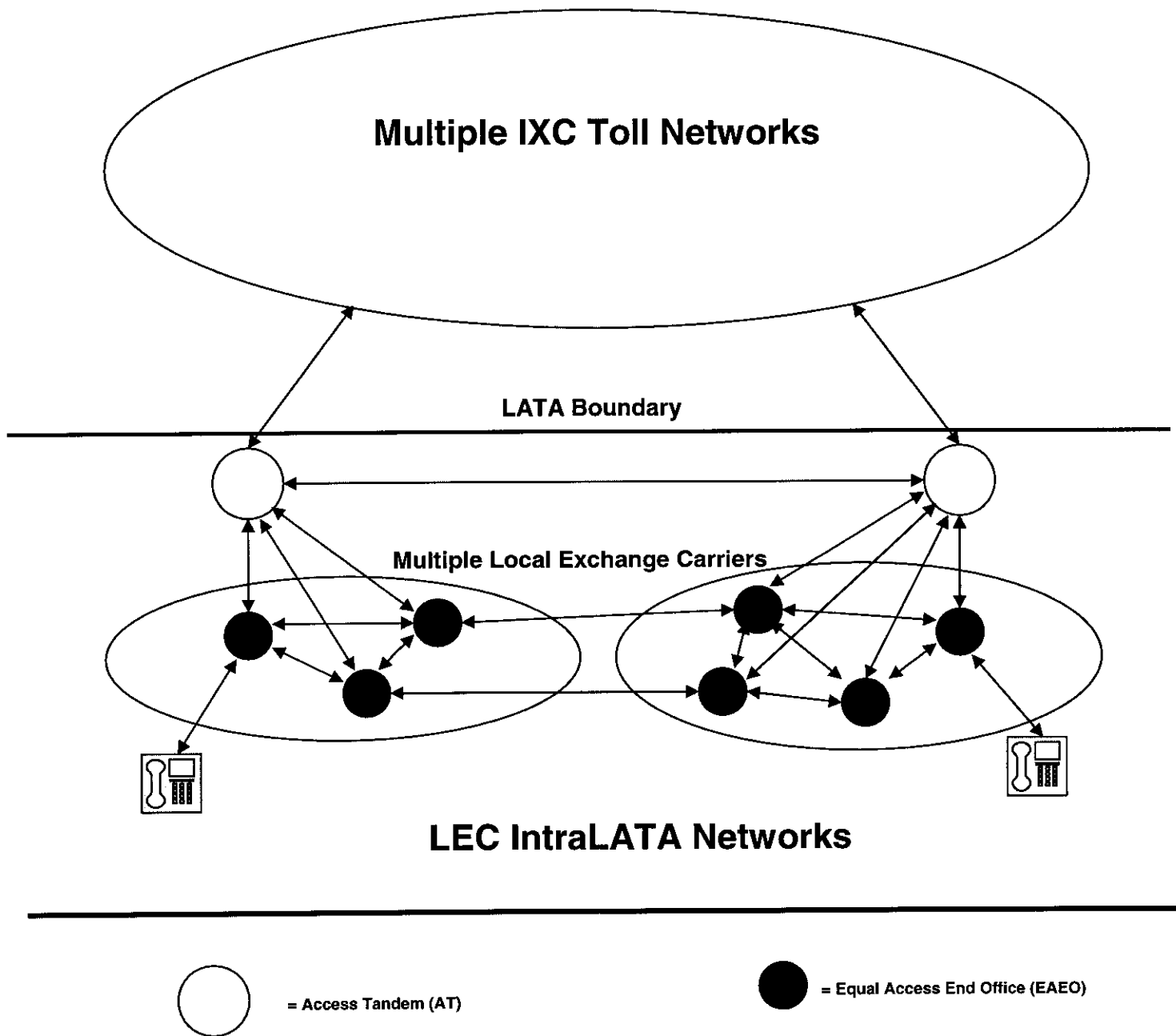
⊖ = Class 4 Toll Center (TC)

⊕ = Class 4 Toll Point (TP)
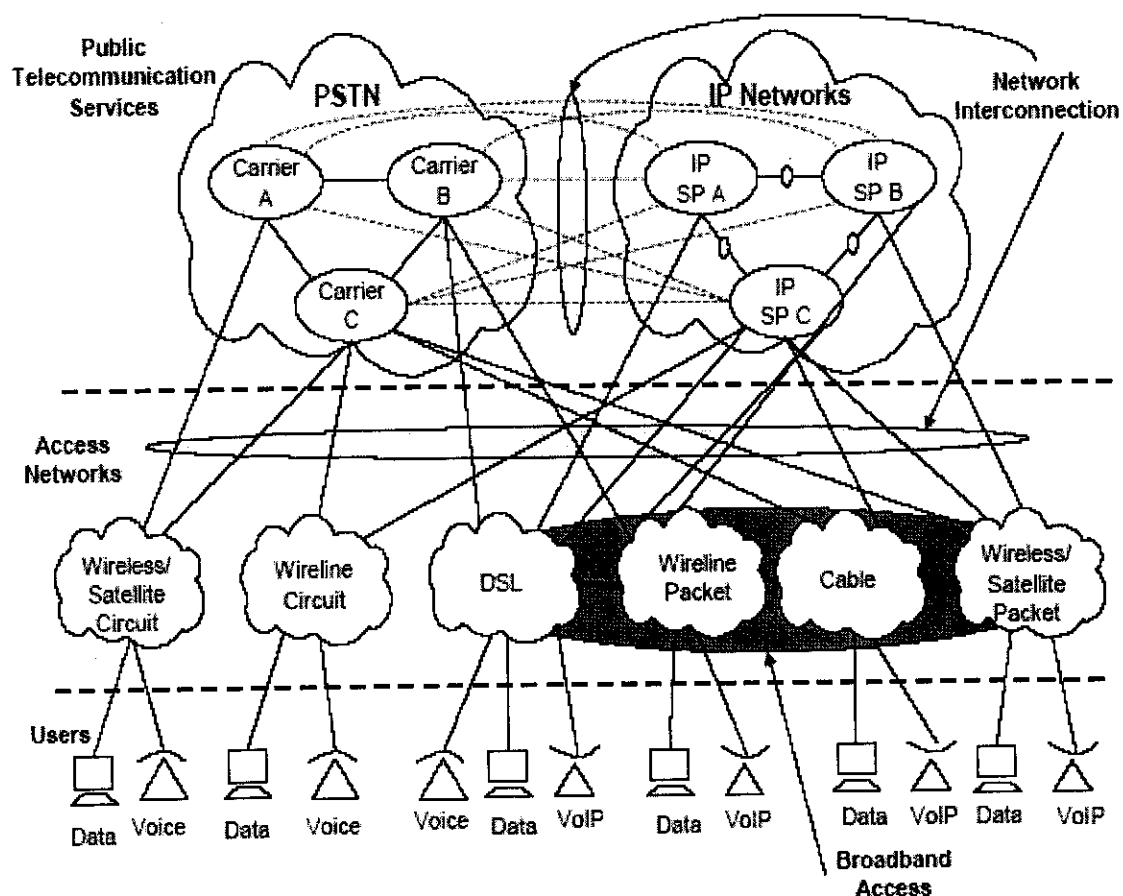
● = Class 5 End Office (EO)

## FIGURE 2 EQUAL ACCESS TOLL DIALING PLAN (POST MFJ)

## FIGURE 3 TOLL AND LOCAL DIALING PLAN POST (TA 96)

**Multiple IXC Toll Networks**

LATA Boundary

**Multiple Local Exchange Carriers**

**LEC IntraLATA Networks**

○ = Access Tandem (AT)

● = Equal Access End Office (EAEO)

## FIGURE 4 HYBRID INTERWORKING NETWORK

## Glossary of Terms

| | | |
|---|---|---|
| AC | Alternating Current | |
| AIN | Advanced Intelligent Network | |
| AMA | Automatic Message Accounting | |
| ANC | All Number Calling | |
| ANI | Automatic Number Identification | |
| AT&T | American Telephone and Telegraph | www.att.com |
| ATIS | Alliance for Telecommunications Industry Solutions | www.atis.org |
| CABS | Carrier Access Billing | |
| CAC | Carrier Access Code | |
| CALEA | Communications Assistance to Law Enforcement Act | |
| CAMA | Centralized Automatic Message Accounting | |
| CCS | Common Channel Signaling | |
| CIC | Carrier Identification Code | |
| CLASS | CUSTOM LOCAL AREA SIGNALING SERVICES | |
| CLEC | Competitive Local Exchange Carrier | |
| CMRS | Cellular and PCS wireless service | |
| CO Code | Central Office Code | |
| COCAG | Central Office Code Assignment Guidelines | |
| CRTC | Canadian Radio Television and Telecommunications Commission | |
| CSCN | Canadian Steering Committee on Numbering | www.cnac.ca/cscn/cscn.htm |
| DC | Direct Current | |
| DDD | Direct Distance Dialing | |
| DMS® | Digital Multiplex System (registered trade mark of Nortel Networks | |
| DOJ | United States Department of Justice | |
| DPT | Dynamic Packet Trunks | |
| DSL | Digital Subscriber Loop | |
| DSMI | Database Service Management Inc. | |
| DTMF | Dual Tone Multi Frequency | |
| EAEO | Equal Access End Office | |
| EO | End Office | |
| FCC | United States Federal Communications Commission | www.fcc.gov |
| FGA | Feature Group A | |
| FGB | Feature Group B | |
| FGC | Feature Group C | |
| FGD | Feature Group D | |
| FNPA | Foreign Numbering Plan Area | |
| GETS | Government Emergency Telecommunications System | www.gets.ncs.gov |
| GTE | General Telephone and Electronics | |
| HNPA | Home Numbering Plan Area | |
| IDDD | International Direct Distance Dialing | |
| IETF | Internet Engineering Task Force | |
| ILEC | Incumbent Local Exchange Carrier | |
| IMTS | Improved Mobile Telephone Service | |
| IN | Intelligent Network | |

| | | |
|---|---|---|
| INC | ATIS Sponsored Industry Numbering Committee | www.atis.org |
| IP | Internet Protocol | |
| ISDN | Integrated Switched Digital Network | |
| ISP | Internet Service Provider | |
| ITU | International Telephone Union | www.itu.int/home/index.html |
| IXC | Interexchange Carrier | |
| LAMA | Local Automatic Message Accounting | |
| LATA | Local Access and Transport Area | |
| LEC | Local Exchange Carrier | |
| LNP | Local Number Portability | |
| MFJ | Modification of Final Judgment | |
| MSA | Metropolitan Statistical Area | |
| MTS | Mobile Telephone Service | |
| NANC | North American Numbering Council | www.fcc.gov/wcb/tapd/Nanc |
| NANP | North American Numbering Plan | |
| NANPA | North American Numbering Plan Administrator | www.nanpa.com |
| NARTE | National Association of Radio and Telecommunications Engineers | |
| NECA | National Exchange Carrier Association | www.neca.org |
| NPA | Numbering Plan Area (aka, Area Code) | |
| OBF | ATIS Sponsored Ordering and Billing Forum | www.atis.org |
| OSS | Operational Support System | |
| PBX | Private Branch Exchange | |
| PIN | Personal Identification Number | |
| POTS | Plain Old Telephone Service | |
| PSAP | Public Safety Answering Point | |
| PSTN | Public Switched Telephone Network | |
| RAO | Revenue Accounting Office | |
| RBOC | Regional Bell Operating Company | |
| SAIC | Science Applications International Corporation | www.saic.com |
| SMS | Service Management System | |
| SNAC | SMS/800 Number Management Committee | |
| SP | Service Provider | |
| SXS | Step-by-Step | |
| TA-96 | Telecommunications Act of 1996 | |
| TBPAG | Thousands-Block Pooling Administration Guidelines | |
| TIA | Telecommunications Industry Association | |
| TPL | Terminal per Line | |
| USITA | United States Independent Telephone Association (Now called United States Telecom Association) | www.usta.org |
| V&H | Vertical and Horizontal Coordinates | |
| VoIP | Voice over Internet Protocol | |
| VSC | Vertical Service Code | |
| VToA | Voice over Asynchronous Transport Mode | |

## Bibliography and Illustrations

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**Notes on the Networks** 2000 Published by Telcordia™
**Notes on V&H Coordinates** 2002 Published by Telcordia™
**AT&T Technical Advisory #3 NPL 81-09-21**
**Telephone, The First Hundred Years**, by John Brooks, Published by Harper & Row in 1976
**Wireless Basics 2ⁿᵈ Edition**, by Harry E. Young, Published by Telephony Books


The following are available from the Alliance for Telecommunications Industry Solutions (ATIS) and were developed for the industry by the Industry Numbering Committee (INC)
**INC 95-0127-005 Carrier Identification Code Assignment Guidelines**
**INC 95-0407-008 Central Office Code Assignment Guidelines**
**INC 96-0802-015 Vertical Service Code Assignment Guidelines**
**INC 99-0127-023 Thousands-block Pooling Assignment Guidelines**
**INC 02-0107-029 Industry Numbering Committee Recommended Plan For Expanding the Capacity of the North American Numbering Plan**
**INC 02-0729-030 North American Numbering Plan Expansion Reference Document**
**INC 03-0110-31 D Digit Report**


The following is a list of web sites that contain a lot of information of telephone networks.
**www.atis.org**
**www.fcc.gov**
**www.telephonetribute.com**
**www.bellsystemmemorial.com**
**www.neca.com**


The following is a list of illustrations included in the text.
**Illustration 1 Early AT&T Bell System Logo 1939**
**Illustration 2 Bell System Logo 1964**
**Illustration 3 Bell Canada Logo 1950s**
**Illustration 4 United States Independent Telephone Association Logo 1923-1955**
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**Illustration 6 Sign identifying the location of a Police Emergency Telegraph**
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